17. *South African Stone-flies (Perlaria), with Descriptions of New Species.*—By K. H. Barnard, D.Sc., F.L.S.

(With 21 Text-figures.)

This paper continues the series of reports * on the fauna of the Cape mountain ranges, which I have been investigating with the aid of grants from the Royal Society of South Africa (1917) and the Research Grant Board. My acknowledgments and thanks are herewith tendered to these bodies.

I also wish to record my grateful appreciation of the help rendered in the field work by my friend Mr. H. G. Wood, whose car has enabled us to visit several localities which otherwise would not have been possible; my thanks are also due to Mr. A. C. Harrison, who is interested in the subject from the point of view of trout, and to Mr. C. W. Thorne of the South African Museum.

The basis of our knowledge of the Nemourid stone-flies in this country is due to Dr. Tillyard (Ann. S. Afr. Mus., vol. xxx, 1931, p. 109), who worked on a small collection from the South African Museum. Nearly all these specimens were dried and pinned, and consequently often in poor condition. Moreover, in dried specimens, where the abdomen is usually shrivelled up, it is difficult to distinguish males from females. Thus in the case of some species it happened that the specimens sent to Dr. Tillyard proved to be females, while others from the same locality, which were retained in the event of the first consignment being lost in transit, proved to be males. It is not surprising that under the circumstances Dr. Tillyard assigned some of the paratype specimens to species to which they did not really belong.

Since then a large amount of fresh material has been collected, and it seems that a revision of all the specimens, including the type material returned by Dr. Tillyard, would be desirable.

A further complication is introduced by the presence of two distinct species occurring not only in the same general locality, but in the same portion of a stream which is being investigated, *e.g.* *A. tabularis* and *A. barnardi*. Thus it happened that males and females were collected together, and the usual assumption that they were conspecific was only disproved later by finding the correct ♂♂ and ♀♀ of both species *in copula*. This is the only safe way of correlating the sexes, and when such pairs are caught they should be preserved in special tubes separate from other captures.

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* Previous reports: see Trans. Roy. Soc. S. Afr., xiv, 1927; xviii, 1929; xix, 1931; xx, 1932; xxi, 1934. Stylops, i, 1932; ii, 1933. Ann. S. Afr. Mus., xxx, 1932.

Genitalia.—For the discrimination of the species the examination of the genitalia is necessary. In all cases a true diagnosis of the species can only be obtained by describing both sexes, though in some cases the males may be of greater importance owing to the often close similarity of the females.

A brief description of the component parts of the male genitalia of the local Nemourine representatives is given here, because Tillyard's paper gives a somewhat confused or even contradictory idea of them, the term "paraproct" being applied to two different structures (*loc. cit.*, pp. 120 and 124). It is not proposed to homologise the structures or to discuss the modifications of the Xth or XIth segments. The identity of the IXth segment is beyond question, the Ist segment being more or less telescoped into the metathorax, its sternite being visible between the posterior pair of coxæ. (For further information on this subject the student may consult Klapalek, 1896, SB.K. Ak. Wiss. Wien, vol. cv, Abt. 1, p. 683, and 1909, Süsswasserfauna Deutschlands, Hft. 8, p. 33; Ris. Entomol. Mitteil., vol. ii, 1913, p. 178; Despax, Bull. Soc. d'Hist. Nat. Toulouse, vol. lix, 1930, p. 139, and vol. lxiv, 1932, p. 185.)

A correct interpretation of the parts cannot be obtained from mounted microscopic preparations, which are flattened under the cover-slip. The genitalia must be examined "in the round," either after treatment with KOH or by simply clearing in a solution of parachlorophenol + chloralhydrate.

The IXth sternite is always more or less produced backwards subtriangularly to form the subgenital plate, and bears at its base a small median obovoid process. The shape of this plate is not a good specific character, as it varies both individually and according to the state of preservation; but the relative size of the basal process is a useful character.

The tergite is simple and unmodified in the genera *Aphanicercella* and *Aphanicercopsis* (as in the Nemourine genera from other parts of the world) (figs. 14, 15), but in *Aphanicerca* bears a characteristic dorsal process projecting backwards, which varies in shape but in all the species hitherto discovered is bifid (figs. 7, 9–13). This process does not arise from the VIIth segment as Tillyard (*loc. cit.*, p. 120) says.

Desmonemoura (fig. 21), with the hind margin of the tergite produced backwards in two processes, may be regarded as an intermediate form, although these processes are an integral part of the tergite, not mobile, and thus quite different from the movable bifid process in *Aphanicerca*.

The end of the abdomen following the IXth segment gives little or no indication of being a composite segment (X + XI). The tergite of the Xth segment is more or less fully chitinised.* A single medio-dorsal chitinised area is found in *Aphanicercopsis* (fig. 14), but in the other three genera there are two such areas, which are either flat (*Aphanicercella*, *Desmonemoura*, figs. 15, 21) or swollen into variously shaped prominences (*Aphanicerca*, figs. 7, 9–13). In the latter genus Tillyard (*loc. cit.*, p. 120) has termed these areas "paraprocts," though, strictly speaking, they lie dorsal to the anus, which is situated between the cerci. In this paper the term paraproct will not be used, and the areas in question will be referred to as the dorsal plate or plates of the Xth segment.

Posterior to the dorsal plate or plates of the Xth segment is a single median process (not a double process as stated by Tillyard, *loc. cit.*, pp. 120, 122), upturned or curved forwards and variously shaped. This is the supra-anal lobe of Klapalek and Ris. In *Aphanicercopsis* and *Aphanicercella* this process does in some positions appear to be composed of two halves owing to the strong chitinisation of the lateral margins. At its base these chitinised margins are continued into two struts, which bend round sharply and articulate with the Xth tergite. In *Aphanicercopsis* they meet the two posterior prolongations of the median dorsal plate (fig. 14). In *Aphanicercella* they connect with a crescentic transverse strut lying behind a more or less triangular-shaped plate interpolated between the two dorsal plates of the Xth segment (figs. 15–17, 19, 20). In *Desmonemoura* they lie between the strongly chitinised inner margins of the dorsal plates, and gradually peter out into the intervening membrane (fig. 21).

The lateral portions of the Xth segment may be termed pleurites. In *Aphanicerca* these areas are feebly demarcated from the tergal portion; in *Aphanicercopsis* they are better defined, and in *Aphani-*

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* The term "chitinised" is used for those areas which are firmer in texture and more or less deeply pigmented, as contrasted with the thin membranous areas like the intersegmental articular membrane.

cercella they form definite plates with acutely produced and strongly chitinised apices; they are capable of considerable lateral movement, and in fact function as claspers (vide *infra*). In *Desmonemoura* they are also well defined, but not capable of much movement in their basal portion; the falcate process is clearly an extreme development of the pointed apex found in *Aphanicercella*, and taken as a whole the pleurite would seem to function as a clasper.

The cerci are attached to, or slightly internal to, the postero-inferior margins of the pleurites (*cf.* Klapalek, 1896; Despax, 1930).

The ventral or sternal portion of the Xth segment is regarded as absent (Klapalek, 1909; Despax, 1930), though Ris (1913) believed the curved struts supporting the subanal lobes and penis (or titillators) to be the remnants of it. Despax (1932) follows this interpretation. The subanal lobes and penis may be the modified remnants of the XIth sternite (Klapalek, 1909; Despax, 1930).

In the South African forms the curved chitinised struts are distinct, short in *Aphanicercella*, but longer in the other genera. They are continued distally, without, however, any articulation or joint, into a median bilobed process of varying shape. This may be termed penis or titillators; the latter term is used here, as this structure does not appear to be the external continuation of the vasa deferentia, though it is in fact an intromittent organ or channel for the passage of the sperm. It is an important diagnostic character of the species.

♀ *Genitalia.*—The vulva is situate on the VIIIth segment, but the position of the subgenital plate varies. In *Aphanicercella* it is on the VIIth segment, but in all the other genera it is on the VIIIth.

The chitinisation of the abdominal segments is variable. Segments II–VI are always membranous, except certain areas on the sternites, which are more or less strongly chitinised. Details of these are given under the different species. In *Aphanicerca* segments VII–X, and in *Aphanicercopsis* segments VIII–X, are completely chitinised. In *Aphanicercella* segments VII, IX, and X are chitinised, while VIII is membranous and pale, except in one species (*nigra*) where there are small chitinised pleural areas. In *Desmonemoura* the tergites of VII and VIII are membranous, the VIIth sternite and genital plate being slightly chitinised; IX and X are chitinised dorsally but membranous ventrally.

Act of Copulation.—In those genera without well-developed pleurites the sexes as a rule separate on being captured. In *Aphanicercella*, however, where the pleurites form claspers, it is comparatively easy to secure and preserve pairs which remain in copula.

In all cases, except *Desmonemoura* in which the act has not been observed, the ♂ and ♀ lie side by side, both abdomens turned slightly towards one another, and the apex of the ♂ abdomen curved upwards and slightly forwards (figs. 1 and 2). In *Aphanicercopsis* and *Aphanicercella* the supra-anal lobe enters the vulva, the denticles on its lower margin engaging the ventral wall of the vulva and serving to anchor the lobe in position. The object of the lobe seems to be to prepare the way for the entry of the more delicate titillators or intromittent organs, which penetrate the oviducts to their full extent.

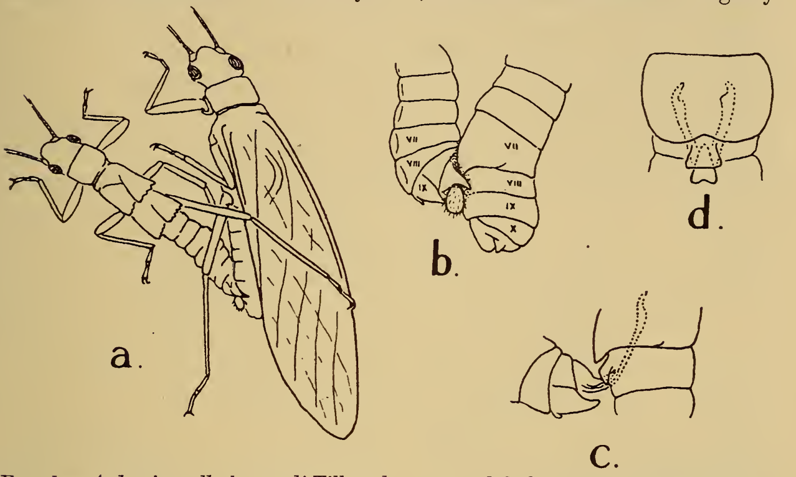

Fig. 1.—*Aphanicercella barnardi* Tillyard. *a*, ♂ and ♀ showing position in copula, wings of ♂ removed; *b*, dorso-lateral view of ♂ and ♀ abdomens; *c*, *d*, lateral and ventral views showing supra-anal lobe and titillators of ♂ within vulva of ♀ (diagrammatic; pleurite and cercus in *c* omitted).

In *Aphanicerca* the mating position is the same, and it cannot be doubted that the supra-anal lobe enters the vulva; but the sexes separate so readily that it has not been possible to secure a pair in copula, in spite of many attempts with the common *A. capensis*. The bilobed dorsal process of the IXth segment probably acts as a clasper.

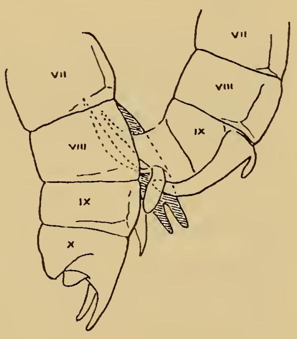

Fig. 2.—*Aphanicercopsis tabularis* n. sp. Semi-diagrammatic view of ♂ and ♀ abdomens in copula.

Oviposition has not been observed, but the ripe eggs of some of the species are described below.

Nymphs of all four Nemourine genera are practically indistinguishable. The correlations with the imagos have been made by collecting examples in the last instar just prior to emergence of the adult. In such examples the wing-cases are black, and the genitalia are visible through the nymph skin and can be easily dissected out.

The adults may be bred out if the nymphs are so far advanced that it is necessary to keep them only a day or two in captivity. Nymphs in earlier stages do not seem to take kindly to confinement in still water, even if frequently changed; but serious attempts to breed them have not been made, as it was found so simple to collect examples ready to hatch.

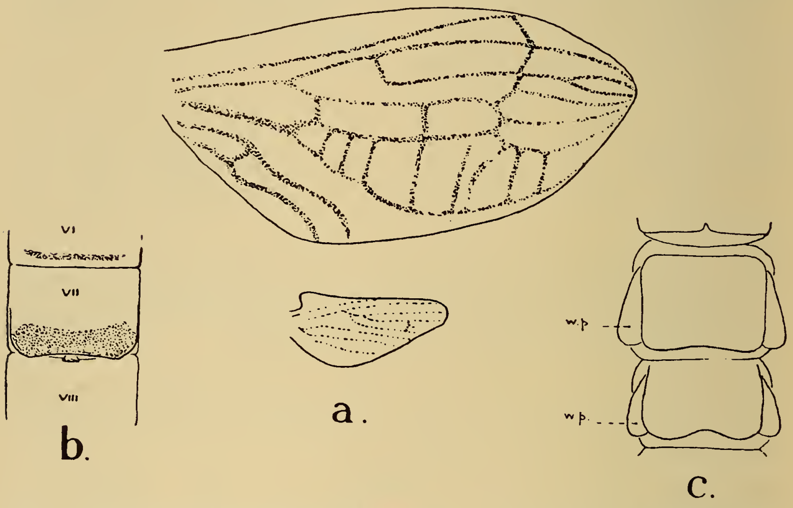

Fig. 3.—Micropterous and apterous forms. *a*, fore- and hind-wing, to same scale, of *Aphanicercella* ♀ from Robinson Pass; *b*, ventral view of abdominal segments VI–VIII of same; *c*, dorsal view of meso- and meta-thorax of ♀ *Aphanicercopsis* from Palmiet River, showing wing-pads (w.p.).

Micropterism and Apterism.—Reduction of the wings in one or both sexes has been recorded in several genera and species (*cf.* Klapalek, 1909, *loc. cit.*; Sharp, Cambr. Nat. Hist., vol. v, 1895, pp. 405, 406; and Despax, *loc. cit.*, 1932, p. 539). Sharp remarks that the phenomena are "worthy of more detailed investigation."

Up to the present only one case of micropterism and two cases of apterism have been observed among South African stone-flies.

A micropterous ♀ of the genus *Aphanicercella* was found at Ruiterbosch, Robinson Pass, Outeniqua Range (K. H. B. and H. G. W., February 1932). The abdomen has very similar characteristics to those of the River Zonder End or Tradouw Pass form of *bifurcata*; the total length is 6 mm., which is about normal for this species (*cf.* figs. 3, *b*, and 18, *b*). (The Outeniqua Range is a continuation of the Langeberg Range in which Tradouw Pass is situated.) The fore-wing measures 2 mm. in length, but shows the typical venation (*cf.* Tillyard, *loc. cit.*, fig. 3), the distal portion of the wing having suffered most from the shortening. All the veins are thicker than in a normal specimen (*cf.* Despax, *loc. cit.*, figs. 1–3). This is not a specimen which has failed to expand its wings on emergence, because the wings normally are very nearly their full size and lie crumpled up within the nymphal wing-pads. The hind-wing is only about a third of the length of the fore-wing, and is markedly degenerate, with very faint and inconspicuous veins.

At Palmiet River (near the village of Kleinmond) Mr. H. G. Wood found two apterous ♀♀ of a species of *Aphanicercopsis*, probably *A. denticulata*, along with normal ♂♂ and ♀♀ of this species. They are 5 mm. in length, as against 7 mm. in the normal winged specimens. Both pairs of wings are represented by short pads (fig. 3, *c*).

An apterous ♂ of *Aphanicercopsis hawaquae* was found at Jonkershoek (K. H. B. and H. G. W., 10th June 1932). It has the characteristic genitalia of this species, and measures 4 mm. in length (normal 5 mm.). It has no trace of wings, not even pads as in the Palmiet River ♀♀.

Economics.—Stone-flies and their nymphs are valuable food for trout in the Western Province. Although abundant at certain seasons, the flies are small and inconspicuous, and consequently not much observed by anglers, except perhaps the Porcupine Stone-fly. This and the Common Cape Stone-fly are the only ones to which colloquial names may usefully be given.

Distribution.—The moderately large stone-flies of the family Perlidae are tropical and subtropical forms. The specimen from Upington on the Orange River and those from Natal constitute the most southerly records in South Africa.

The Nemourine stone-flies, on the other hand, are a temperate group. So far as yet known, they occur in the Cape mountain ranges, as far north as the Cedar Mountains (Clanwilliam District) and as far east as George. It would be very interesting to discover how much farther east they extend.

The Common Cape Stone-fly (*Aphanicerca capensis*) and its varieties has a fairly wide distribution in the Western Cape Province, and occurs more or less throughout the year. The other species of this genus and those of *Aphanicercopsis* and *Aphanicercella* appear to be more local, though this may be due to lack of collecting just at the right season. The species of these latter two genera seem to be winter, spring, and early summer flies, at least in the western portions of the Cape region.

FAMILY PERLIDAE.

1909. Klapalek, Süsswasserfauna Deutschlands, Hft. 8, p. 42 and p. 84 (nymph).
1923. *Id.*, Coll. Zool. Selys Longchamps, fasc. iv, 2, p. 9.
1921. Rousseau, Larves et Nymphes Aquatiques, vol. i, p. 291 (nymph).

Subfamily NEOPERLINAE.

1931. Tillyard, Ann. S. Afr. Mus., vol. xxx, p. 114.

Two ocelli. Two axillary veins (*i.e.* a forked 2A) from basal anal cell in fore-wing.

Gen. *Ochthopetina* End.

1909. Enderlein, Stettin. Entomol. Zeit., 70 Jahrg., p. 324.
1909. *Id.*, Zool. Anz., vol. xxxiv, p. 398 (key to species).
1923. Klapalek, *loc. cit.*, p. 175.
1931. Tillyard, *loc. cit.*, p. 114.

The ocelli much nearer to one another than to inner margins of eyes. No cross-veins beyond the anastomosis (transverse cord) except in pterostigmal area. Cerci long. First two tarsal joints very short, 3rd long. Fused Rs + MA in hind-wing usually longer than its branches (as far as anastomosis), or at least as long as the shorter (MA) branch. Wings folded back flat over abdomen. IXth sternite in ♂ somewhat parabolically produced. Xth (or XIth) tergite with 2 medianly directed blunt processes, each bearing a forwardly directed slender process. Subgenital plate ♀ (VIIIth sternite) not, or only a little, broader than the other sternites, sometimes extended by an accessory plate on mid-hind margin.

Nymph with 4 or 6 pairs of thoracic gill-tufts and one pair of anal gill-tufts. Inner lobes of labium small. Labial and maxillary palps slender. First 2 tarsal joints very short.

Remarks.—Tillyard accepts Enderlein's genus, saying he is unable to criticise the grouping of the Ethiopian and Oriental species in a genus distinct from *Neoperla.* Klapalek also accepts the genus. Navas (Rev. Zool. Afric., vol. xxi, 1931, p. 2, and vol. xxii, 1932, p. 3) has described further new species from the Congo under the name *Neoperla,* based on ♀♀ only, and consequently of doubtful validity.

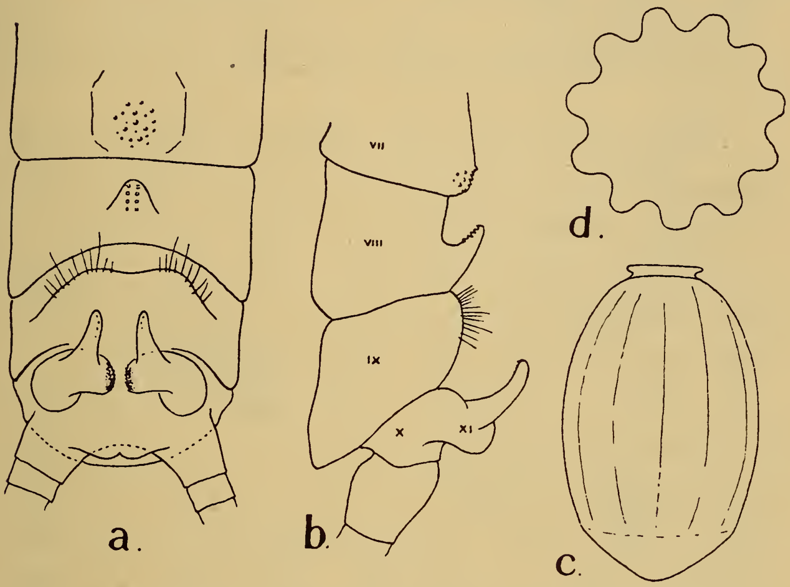

FIG. 4.—*Ochthopetina transvaalensis* (End.). *a, b,* dorsal and lateral views of end of abdomen ♂; *c, d,* lateral view and cross-section of egg.

Ochthopetina transvaalensis (End.).

1909. Enderlein, Zool. Anz., vol. xxxiv, p. 402 (♀).
1923. Klapalek, *loc. cit.*, p. 140, fig. 13 (♀).
1931. Tillyard, *loc. cit.*, p. 115, fig. 1 (part).

Tillyard has mentioned the variability of the venation and other features.

Enderlein's description of the VIIIth sternite of ♀ is correct, viz. not differing from the other sternites, with straight hind margin and without sculpture. The appearance described by Klapalek is erroneous and due to shrinkage (I have examined the two specimens returned to the South African Museum with Klapalek's labels—Klapalek evidently did not relax either of them).

♂ *Genitalia* (fig. 4).—VIIth tergite with a slightly more strongly chitinised squarish patch bearing a median group of conical granules or denticles; VIIIth tergite with a median conical forwardly directed process bearing 2 rows of denticles on its lower (anterior) surface; IXth tergite with 2 broadly rounded humps bearing long setae but no granules; copulatory processes with a few denticles apically on their lower surfaces.

Eggs (fig. 4) not quite ·5 mm. in length, barrel-shaped, with 11–13 rounded longitudinal ribs and a reflexed rim at the micropylar end.

Nymph (fig. 5).—Klapalek (1912, Ergebn. Deutsch. Zentralafr. Exp. III Zool., vol. i, pp. 447 sqq.) has described one form of *Neoperla* nymph from Rukarara stream, Ruanda, and two others from west of Lake Albert Edward. All these forms possess 7 pairs of gills.

Lestage (1917, Rev. Zool. Afric., vol. v, 2, pp. 135 sqq.) has described three specimens, all collected on the same day and at the same locality (Maba River, near Mlonda), which he apparently considers as representing three species. Each one possesses 5 pairs of gills.

The specimens here described resemble Klapalek's specimens in having 7 pairs of gills, and are without doubt to be assigned to *transvaalensis.* Some full-grown specimens were collected by Mr. S. A. Hey on the Inland Fisheries Survey, either in Natal or the Transvaal. One empty shuck came from Krantzkop (K. H. B., 1917), the same locality where the above described ♂ was caught; and three half-grown specimens were collected by Mr. J. C. Dendy in the Olifants River, near Satara, Transvaal.

Size.—Up to 17 mm.; cerci 10 mm.; width of pronotum 3·5 mm. This is about the maximum size (for ♀♀), as the empty shuck also measures 17 mm.

Colour (as preserved).—Castaneous or sepia brown; legs, cerci, and antennae ochraceous; light ochraceous patches as follows: a band between the eyes, a transverse bilobed patch on prothorax, a subtriangular or cordate patch on both meso- and meta-thorax and on hinder half of Xth abdominal segment, transverse bands on hind margins of abdominal segments II–IX; gill-tufts whitish.

The structural details will be seen from the figure. The position of the gill-tufts correspond with Klapalek's description. The tuft above the insertion of fore-leg is really a double gill, as is also that above the middle leg, but is counted as only one.

In some of the full-grown nymphs eggs are already developed, and agree with those extracted from the imago (*supra*).

Remarks.—The original Zoutpansberg specimen was a ♀, and the Lydenburg specimen (editor's footnote in Tillyard, p. 115) is also

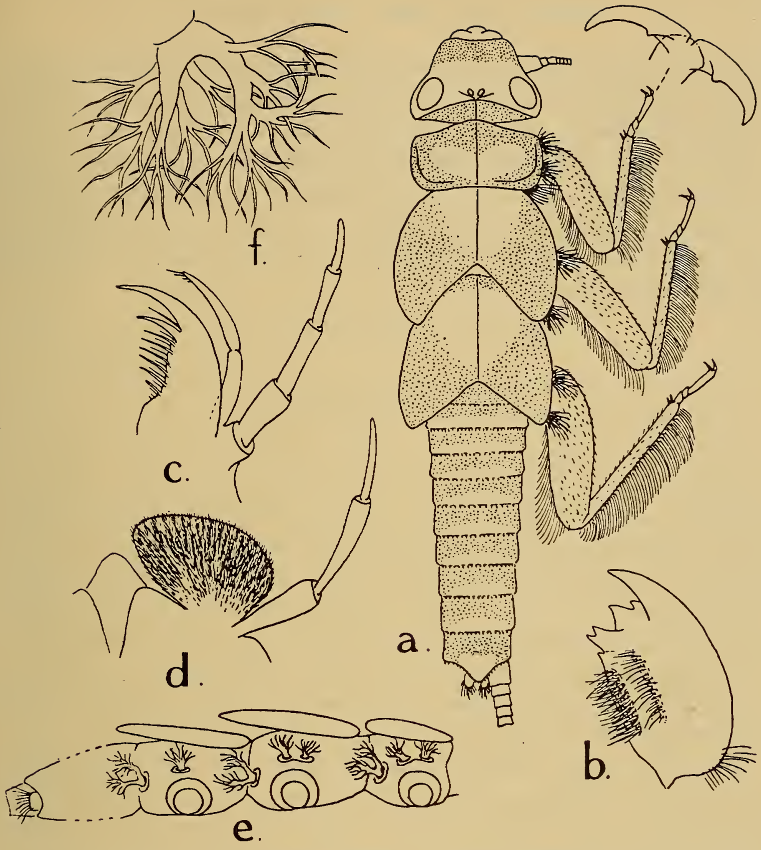

FIG. 5.—*Ochthopetina transvaalensis* (End.). *a*, nymph, with claw further enlarged; *b*, ventral view of mandible; *c*, *d*, maxilla and labium, the median lobe in the latter figure is the hypopharynx; *e*, semi-diagrammatic lateral view of thorax and end of abdomen (other abdominal segments and the right cercus omitted) to show gill-tufts; *f*, a double gill from between pro- and mesothorax.

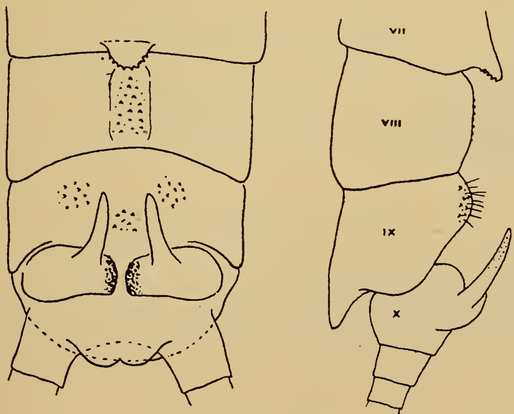

FIG. 6.—*Ochthopetina kunenensis* n. sp. Dorsal and lateral views of end of abdomen ♂.

a ♀. As no ♂ is known from the Transvaal, it is therefore an assumption to identify the Natal and Zululand specimens with this species, though the identity will probably prove to be correct.

The only ♂ I have seen is the Krantzkop specimen. The genitalia are very similar to those of *leroiana* Klap. (see 1923, p. 138, figs. 11, 12) from Redjaf in the Lado Enclave. In fact, but for the difference in shape of the pronotum, there might be some reason for considering *leroiana* a synonym.

Ochthopetina kunenensis n. sp.

1931. Tillyard, *loc. cit.*, p. 115 (*transvaalensis* part, non End.).

Resembling *transvaalensis* in all characters, including the VIIIth sternite of ♀, but distinguished by the ♂ genitalia.

♂ (fig. 6).—VIIth tergite with conical, backwardly projecting median process on hind margin, bearing denticles; VIIIth tergite with a slightly more strongly chitinised median band bearing conical granules or denticles; IXth tergite with 2 rounded humps bearing conical denticles and long setae, and between the humps a third patch of denticles; copulatory processes slender, without any denticles.

Colour and size as in *transvaalensis*, ♂♂ smaller than ♀♀.

Locality.—Erikson's Drift and Otjimbumbe, Kunene River, South West Africa (K. H. B. and R. F. Lawrence, March 1923).

Remarks.—The ♂ genitalia closely resemble those of *africana* Klap. (see 1923, p. 133, figs. 4, 5) from the Cameroons, but differ in the shape of the chitinised patch on the VIIIth tergite, and the presence of a third group of denticles on the IXth tergite.

The Upington specimen (editor's footnote in Tillyard, *loc. cit.*, p. 115) is a ♀, and consequently unidentifiable. It would be extremely interesting to obtain a ♂ from this, or some other locality, on the Orange River.

FAMILY NEMOURIDAE.

1909. Klapalek, *loc. cit.*, p. 69 and p. 92 (nymph).
1921. Rousseau, *loc. cit.*, pp. 119 (nymph), 314.
1926. Tillyard, Insects Austr. and New Zeal., p. 119.

Three ocelli.

Subfamily NEMOURINAE.

1931. Tillyard, *loc. cit.*, p. 116.

Second tarsal joint much shorter than either of the others.

Nymph without gill-tufts (in the South African species).

Remarks.—The nymphs of the species of the four genera described below are extraordinarily alike. Only nymphs in the last instar showing the genitalia of the imago within the nymphal skin, and the empty shucks of specimens bred in captivity, have been used in these descriptions. The correlations therefore are beyond doubt.

Tillyard (*loc. cit.*, pp. 128, 129, figs. 12, 13) briefly mentioned two nymphs, one of which was ascribed to *Aphanicerca* on the wing venation. As, however, the wing venation offers no reliable differential characters between the local genera, the identity of that nymph remains indeterminable.

Gen. *Aphanicerca* Tillyard.

1931. Tillyard, *loc. cit.*, p. 117.

Imago.—No cross-veins beyond the anastomosis, except the distal intercubitals. Sc ending on costa at about the middle. Rs arising almost or quite perpendicularly from R. MA arising at an angle separately from Rs. All veins distal from the anastomosis (transverse cord) evenly spaced, subparallel. Between MA and Cu_1 only 2 (rarely 3) cross-veins proximal to anastomosis. In hind-wing Rs and MA arising by short common stalk from R; a single intercubital cross-vein distal from the anastomosis; anal fan narrow, with 5 simple veins. Wings folded back and slightly wrapped round the abdomen; more or less suffused; fore-wing with clear patch in middle.

IXth tergite ♂ with backwardly directed bifid process; IXth sternite elongate, more or less triangular, with short median basal process. Xth tergite divided into two variously shaped, gibbous plates, behind which is the recurved supra-anal lobe. Titillators more or less elongate; internal supporting struts slender, long. Pleurites not well demarcated. Cerci short, cylindrical, one-jointed.

In ♀ abdominal segments VII–X completely chitinised; segments II–VI with chitinised plates on sternites only. These plates are more or less trapezoidal, but may be reduced to a band across the posterior half of each segment, though those on segments II and VI are seldom reduced. Subgenital plate on VIIIth segment, more or less produced. Subanal plates more or less triangular. Cerci very short, conical.

Egg and nymph, see under *capensis*.

Genotype.—*A. capensis* Tillyard.

Remarks.—The nymph of *capensis* is known, but not those of the other species. In view of the similarity of the nymphs in the four Nemourine *genera* there are hardly likely to be any *specific* differences.

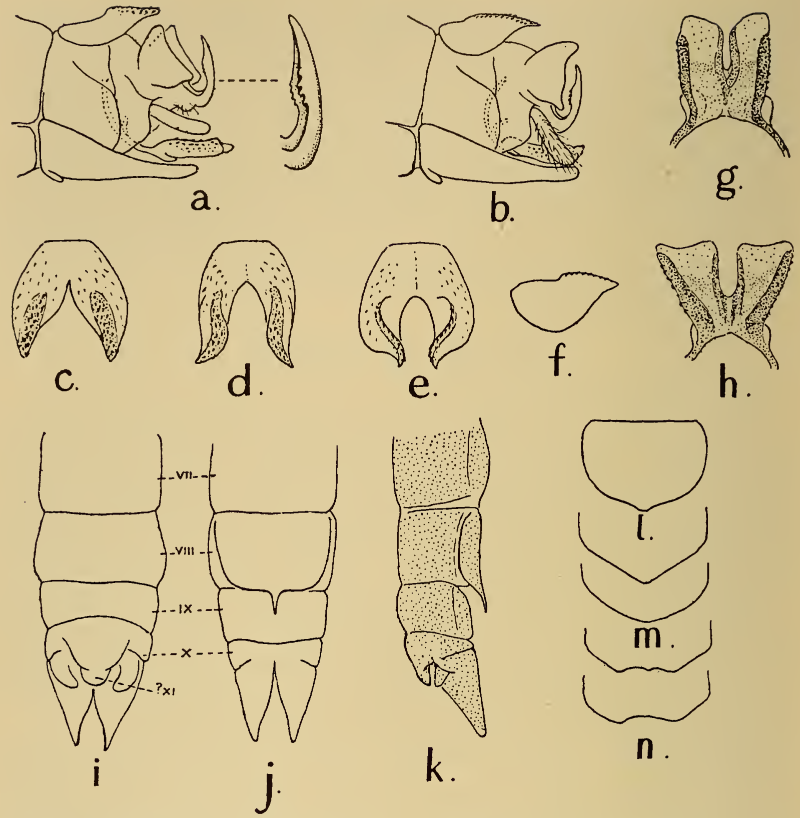

Fig. 7.—*Aphanicerca capensis* Tillyard. *a*, lateral view of genitalia of ♂ from Table Mt. (typical form), with supra-anal lobe further enlarged; *b*, the same of specimen from Wellington Mts., in normal resting or retracted position; *c*, *d*, dorsal view of dorsal processes of Table Mt. and Wellington forms respectively; *e*, *f*, dorsal and lateral views of same of Montagu Pass form; *g*, *h*, dorsal view of titillators of Table Mt. and Tulbagh Valley forms respectively; *i*, *j*, *k*, dorsal, ventral, and lateral views of abdomen of ♀ from Table Mt.; *l*, *m*, *n*, subgenital plate of ♀ of vars. *a*, *β*, *γ* respectively, two varieties each of vars. *β* and *γ*.

Aphanicerca capensis Tillyard.

(Common Cape Stone-fly.)

1931. Tillyard, *loc. cit.*, p. 119, figs. 2–4 (part: holotype from Table Mt., and paratypes from Wellington, Klein Drakenstein, and Tulbagh).

Imago.—In addition to the characters given by Tillyard, the frontal warts on head are small, subcircular, about one ocellus-diameter in front of, and slightly external to, the hinder ocelli. Fork of R_{2+3} and R_{4+5} in fore-wing sometimes sessile or almost so, sometimes the stalk as long as or even a trifle longer than the cross-vein R_{2-5}–MA_1.

♂ *Genitalia.*—Dorsal process of IXth tergite divided into two lanceolate halves, each with a band of posteriorly directed spinules or denticles distally, the length of the band about half length of the process. Dorsal plates of Xth segment upstanding, in side view quadrangular, bluntly pointed at both ends. Supra-anal lobe scimitar-like, with 4–5 denticles in middle of each margin of the groove on its concave (anterior) face. Titillators robust, the lateral strongly chitinised margins bearing spinules, the membranous apex rounded or truncate, the inner chitinised supports not produced.

♀ *Genitalia.*—Subgenital plate broadly ovoid, with narrow acute median point on hind margin. Very occasionally specimens with a blunt point (see var. *a*, *infra*) are found. Subanal plates triangular, apically acute.

Fore-wing.—♂ 7–8 mm., ♀ 8–9 mm. (sometimes 10 mm.).

Colour as given by Tillyard.

Eggs round-oval, ·18–·2 mm. long diameter, surface feebly reticulate, no micropylar projection.

Nymph.—General characters as in fig. 8. Prothorax transversely subquadrangular. Labrum transverse, distal margin very slightly concave. Mandibles often with the main cutting teeth more worn down and blunter. Maxillary palp not extending much beyond the galea and lacinia, which are subequal. Labium with outer lobes somewhat stouter than the inner lobes. Both the maxillary and labial palps show a minute rudiment of another joint on the terminal joint; this is best seen in empty shucks. Spinules on the wing-cases short, acute. Legs and abdomen shortly hirsute and with short spinules.

Length up to 7–8 mm.

Colour.—Uniformly ochraceous, the knees and wing-cases becoming dark before emergence of the imago.

Locality.—Typical (holotype) form, streams on the slopes of Table Mt., Cape Town.

Specimens from localities outside the Cape Peninsula show slight variations in the ♂ and ♀ genitalia, but not enough to justify varietal names.

Var. a (1931, Tillyard, *loc. cit.*, p. 121, paratype ♂ and ♀ from Wellington and Klein Drakenstein).—Usually somewhat smaller than

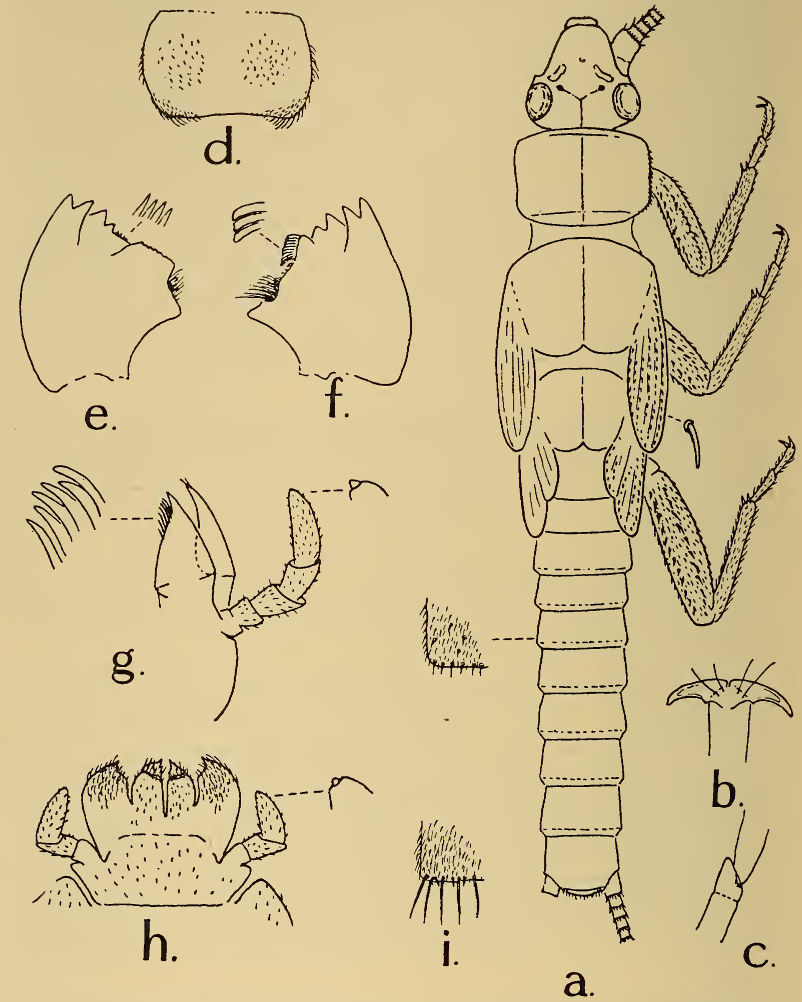

Fig. 8.—*Aphanicerca capensis* Tillyard. *a*, nymph, with portion of abdominal integument further enlarged; *b*, *c*, claw and junctions of the three tarsal joints further enlarged; *d*, labrum; *e*, *f*, right and left mandibles from below; *g*, *h*, maxilla and labium.
Aphanicercella barnardi Tillyard. *i*, portion of abdominal integument for comparison with that of *Aphanicerca*.

the Table Mt. form; fore-wing ♂ 6·5–7, ♀ 8–9 mm. (paratype ♂ has wings 6·5, not 5·8 mm. as given by Tillyard). Dorsal processes of IXth tergite ♂ shorter, deeper in lateral view, with relatively longer band of spinules. Subgenital plate ♀ with short, blunt median point, which is sometimes almost obsolete.

Localities.—Wellington Mts., Seven Sisters (K. H. B., October 1931) and Witte River (H. G. W., October 1933).

Fairy Glen, Brandwacht, Worcester (K. H. B. and H. G. W., August 1932).

Gt. Winterhoek Mts., Tulbagh (K. H. B., September 1932; K. H. B. and H. G. W., November 1932).

French Hoek Pass (east side) (K. H. B. and H. G. W., December 1932 and October 1933).

Bosch Kloof, Keeromberg, Worcester (H. G. W., January 1933).

Cedar Mts., Clanwilliam (K. H. B., October 1934).

Var. β (1931, Tillyard, *loc. cit.*, p. 121, paratype ♂ and ♀ mounted on slides, Gt. Winterhoek Mts.).—Subgenital plate ♀ with evenly rounded hind margin, sometimes somewhat angular but without any definite point. The titillators in ♂♂ from the Tulbagh Valley are broader than in the typical form.

Locality.—Gt. Winterhoek Mts., in the Sneeuwgat (Twenty-four Rivers drainage system) and streams on the Tulbagh side (Little Berg River system) (K. H. B., September 1932; K. H. B. and H. G. W., November 1932 and October 1933).

Var. γ.—Subgenital plate ♀ apically truncate and slightly excavate, with or without a slight median point.

Localities.—Palmiet River, Southern Hottentots Holland Mts., near Kleinmond (H. G. W., July 1932 and December 1933).

Hottentots Holland Mts. (Landdrost) (K. H. B., January 1916 and January 1933).

Oudebosch, River Zonder End Mts. (H. G. W., January and September 1933; K. H. B. and H. G. W., January 1934).

At the following localities only ♂♂ have been captured. In ♂♂ from Montagu Pass the dorsal processes of IXth tergite are very deep in lateral view, and in dorsal view are more strongly incurved (fig. 7, *e*, *f*).

Robinson Pass, Outeniqua Mts., north of Mossel Bay (K. H. B. and H. G. W., February 1932).

Montagu Pass, Outeniqua Mts., north of George (H. G. W., April 1933).

Remarks.—In the Cape Peninsula a succession of broods occurs throughout the year, except for a short period in mid-winter and late summer, corresponding with the wettest and driest months. The actual dates between which no imagos have been found are

1st May to 11th July and 7th January to 29th March. After the summer break the young nymphs begin to appear towards the end of February and early in March.

The flies are found on rocks projecting from and bordering the streams or on neighbouring tree-trunks and bushes. They run rapidly when disturbed and take short flights. On calm warm evenings they can be seen rising above the vegetation and taking more sustained flights.

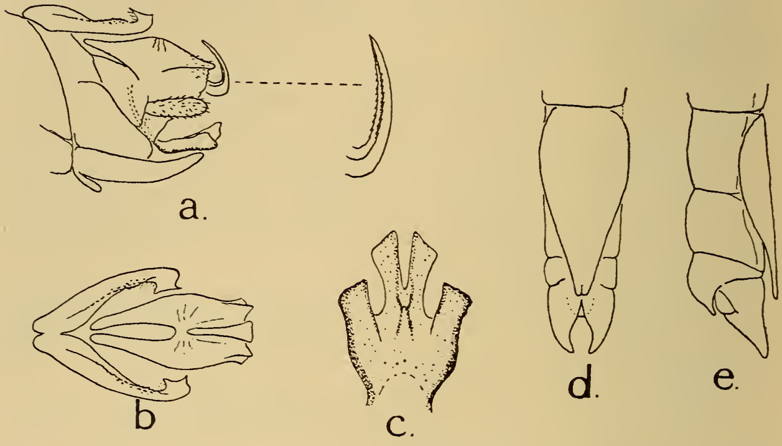

Fig. 9.—*Aphanicerca uncinata* n. sp. *a*, lateral view ♂ genitalia with supra-anal lobe further enlarged; *b*, dorsal view of dorsal processes of IXth and dorsal plates of Xth segments; *c*, titillators; *d*, *e*, ventral and lateral views ♀ genitalia.

Aphanicerca uncinata n. sp.

Imago.—Venation and other characters as in *capensis.*

♂ *Genitalia.*—Dorsal process of IXth tergite divided almost from base into two slender, divergent, apically recurved and truncate processes, their dorsal margins raised and spinulose before the bend and setulose in the bend. Dorsal plates of Xth tergite fusiform, with strong anterior projection; supra-anal lobe scimitar-like, tapering evenly, with several small serrulations on each margin of the groove on its concave face. Titillators bilobate, margin of outer lobes strongly chitinised, not spinulose, the margin of inner lobe not so strongly chitinised, both lobes apically truncate.

♀ *Genitalia.*—Subgenital plate of VIIIth segment elongate, extending beyond end of IXth sternite, lanceolate, tapering to a subacute or narrowly rounded apex, which is shortly cleft. Subanal plates triangular, apically acute.

Fore-wing.—♂ 4·5–6 mm., ♀ 7–8 mm.

Colour as in *capensis.*

Locality.—Hottentots Holland Mts. (east side of the Sneeuwkop, Landdrost Kop, and Sugar Loaf) (K. H. B., January 1916, 3 ♂♂, 1 ♀, and March 1919, 1 ♀; K. H. B. and H. G. W., January 1933, ♂♂♀♀).

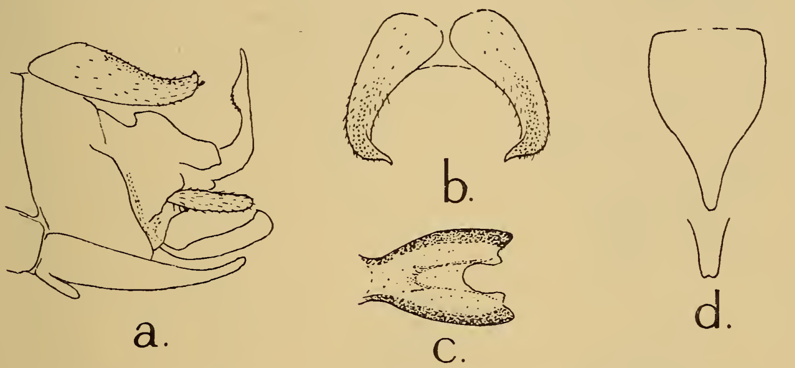

Fig. 10.—*Aphanicerca lyrata* n. sp. *a*, lateral view ♂ genitalia; *b*, dorsal view of dorsal processes of IXth segment; *c*, titillators; *d*, subgenital plate ♀.

Aphanicerca lyrata n. sp.

1931. Tillyard, *loc. cit.*, p. 121 (paratype ♀ from Jonkershoek).

Imago.—Venation and other characters as in *capensis.*

♂ *Genitalia.*—Dorsal process of IXth tergite divided into two stout, divergent, apically incurved processes, strongly chitinised distally, dorsal margins in distal half minutely denticulate. Dorsal plates of Xth tergite with anterior corner not very prominent, shortly acute; supra-anal lobe as in *capensis* but with more prominent convexity bearing the serrations. Titillators lobiform, apically blunt, in section like two angle-iron pieces |__..__| connected ventrally by feebly chitinised membrane; apices somewhat sharply incurved; outer margin not spinulose.

♀ *Genitalia.*—Subgenital plate not quite so elongate as in *uncinata*, rapidly narrowing in distal half to a sharp apex, which may be minutely notched. Subanal plates acute.

Fore-wing.—♂ 7–7·5 mm., ♀ 8–9 mm.

Colour as in *capensis.*

Locality.—Jonkershoek, Stellenbosch (K. H. B., May 1924, 1 ♀; H. G. W., May 1932, 3 ♂♂, 5 ♀♀; K. H. B. and H. G. W., June 1932, ♂♂♀♀).

Aphanicerca bicornis n. sp.

Imago.—Venation and other characters as in *capensis.*

♂ *Genitalia.*—Dorsal process of IXth tergite divided from near base into two slender (sometimes a little stouter than represented in the figure, but never as stout as in *lyrata*), widely separated, subparallel or curved processes bearing granules and stout conical spinules dorsally in distal half; apices acute. Dorsal plates of Xth tergite similar to those of *lyrata*, but anterior angle more rounded, posterior half strongly chitinised, with minute denticles; supra-anal lobe thin, with a feeble bulge where the denticles are situated. Titillators lobiform, similar to those of *lyrata.*

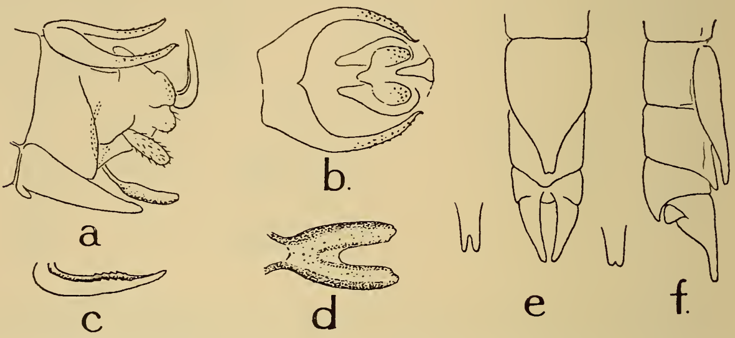

Fig. 11.—*Aphanicerca bicornis* n. sp. *a*, lateral view ♂ genitalia; *b*, dorsal view of dorsal processes of IXth, and dorsal plates of Xth segments; *c*, supra-anal lobe; *d*, titillators; *e*, *f*, ventral and lateral views ♀ genitalia, with variations of apex of subgenital plate.

♀ *Genitalia.*—Subgenital plate lanceolate, produced to a feebly bifid or shortly cleft setose point, extending almost to end of IXth sternite. Subanal plates triangular, abruptly narrowed in middle; apices acute.

Fore-wing.—♂ 6–7·5 mm., ♀ 8–8·5 mm.

Colour as in *capensis.*

Localities.—Du Toit's Kloof, Rawsonville (K. H. B., 1st June 1930, 1 ♂).

Bain's Kloof, Wellington Mts. (east side) (K. H. B. and H. G. W., 1st May 1933, 1 ♂, 2 ♀♀).

Fouche's Hoek, Mostertshoek Mts. (K. H. B., 17th April 1933, ♂♂).

Zanddrift Kloof, Hex River Mts., Worcester (K. H. B., 20th April 1930, 1 ♀).

Jan du Toit's Kloof, Waaihoek (R. Anson Cook, 13th May 1934, 1 ♀).

French Hoek Pass (east side, River Zonder End headwaters) (H. G. W., 7th May 1933, 3 ♂♂, 1 ♀).

The first five localities are in the Breede River system; the River Zonder End eventually also joins the Breede River.

Aphanicerca bovina n. sp.

Imago.—Venation and other characters as in *capensis.*

♂ *Genitalia.*—Dorsal process of IXth tergite divided from near base into two lanceolate processes, the acute apices slightly curved, dorsal surface distally setose and spinulose. Dorsal plates of Xth tergite anteriorly broadly rounded, distally sharply acute in lateral view, crenulate in dorsal view; supra-anal lobe thin, with scarcely any convexity where the denticles are situated. Titillators bilobed, outer lobe with strongly chitinised outwardly curving margin, which has an acute apex, and 3–4 minute denticles on an inner projecting bend; inner lobe narrow, feebly chitinised, ending in a minute spinule; outer and inner lobes connected by setulose membrane. ♀ unknown.

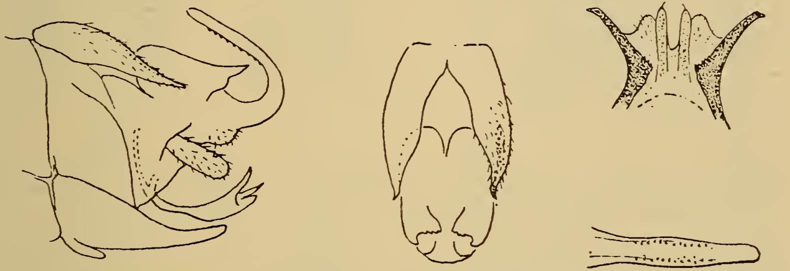

FIG. 12.—*Aphanicerca bovina* n. sp. *a*, lateral view ♂ genitalia; *b*, dorsal view of dorsal processes of IXth, and dorsal plates of Xth segments; *c*, titillators; *d*, inner (anterior) view of supra-anal lobe.

Fore-wing.—5–5·5 mm.

Colour as in *capensis.*

Locality.—French Hoek Pass (east side) (H. G. W., 1st October 1932, 1 ♂, 19th November 1933, 1 ♂, and 16th September 1934, 1 ♂).

Aphanicerca tereta n. sp.

Imago.—Venation and other characters as in *capensis.*

♂ *Genitalia.*—Dorsal process of IXth tergite divided into two lanceolate halves, each with a distal band of posteriorly directed spine-setae (not short conical spinules as in *capensis*), and 3–4 sharp denticles on inner distal margin. Dorsal plates of Xth tergite with projecting anterior corner and somewhat acute posterior corner; supra-anal lobe slender, terete, curved, with a double row of stout conical spinules on the concave surface. Titillators (all specimens have been set and dried and the genitalia rather mutilated) similar to those of *capensis*, but the outer margin is setulose instead of spinulose. ♀ unknown.

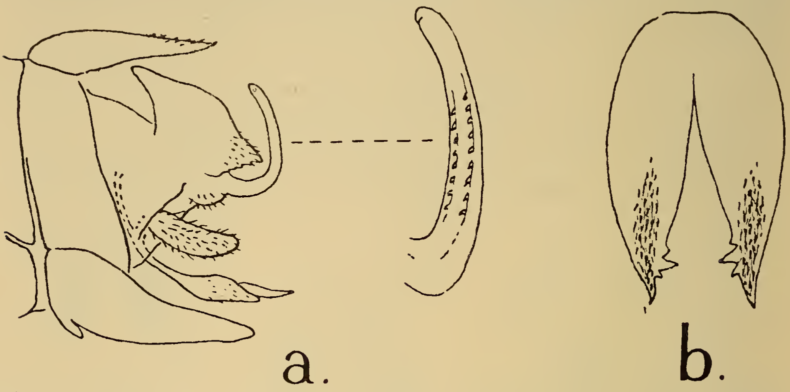

Fig. 13.—*Aphanicerca tereta* n. sp. *a*, lateral view ♂ genitalia, with supra-anal lobe further enlarged; *b*, dorsal view of dorsal processes of IXth segment.

Fore-wing.—6·5 mm.

Colour as in *capensis*.

Locality.—River Zonder End Mts. (K. H. B., November 1928, 4 ♂♂).

Remarks.—Some ♀♀ obtained in the same locality resemble those of *capensis* var. γ, which also occurs there, so that it is uncertain to which species they belong.

Aphanicerca sp.

1931. Tillyard, *loc. cit.*, p. 121 (paratype ♀ from Lemoenshoek).

The subgenital plate of ♀ is similar to that of *capensis*, but the subanal plates are short and rounded. In this respect these ♀♀ differ from the normal *capensis*, but until ♂♂ are found at the same locality they should not be assigned to any particular species.

Aphanicercopsis n. g.

Imago.—Venation as in *Aphanicerca*. Wings rather strongly suffused, unicolorous, without clear patch in fore-wing.

IXth tergite ♂ without process, sternite elongate, with median process at base. Xth tergite with flat, shield-like chitinised area,

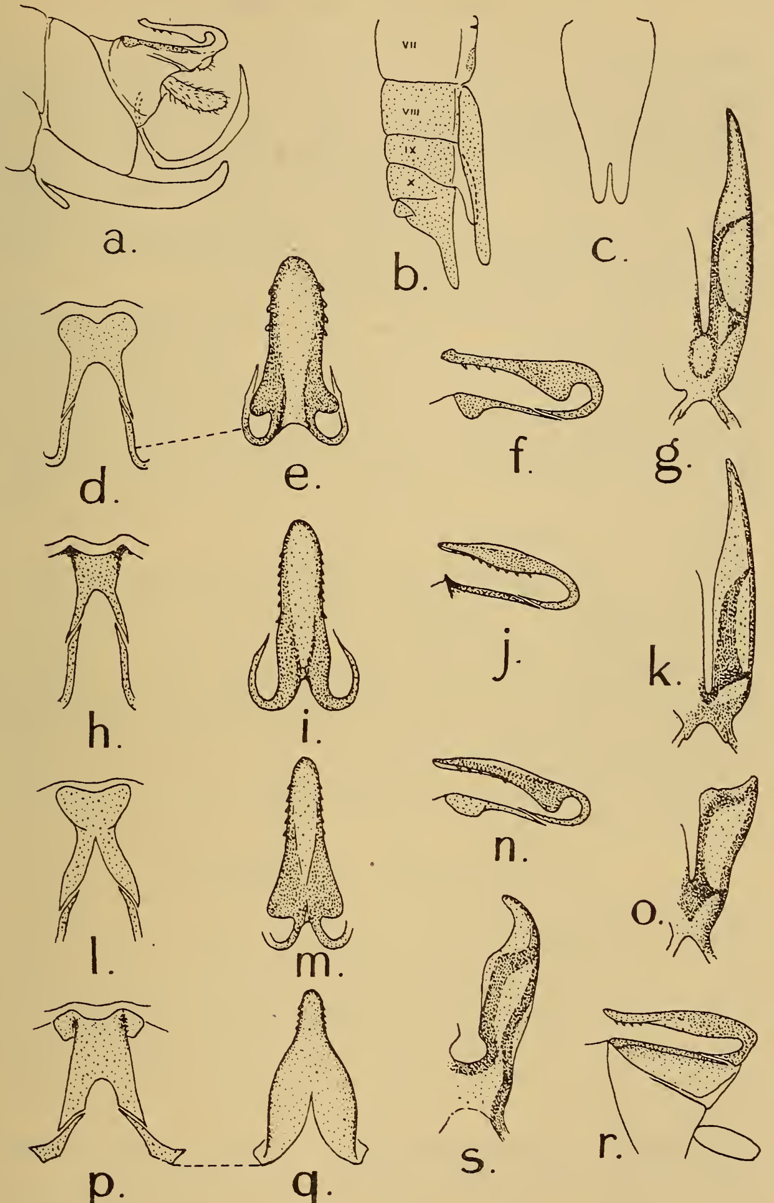

Fig. 14.—*Aphanicercopsis* n. g. *A. tabularis* n. sp. *a*, lateral view ♂ genitalia; *b*, lateral view ♀ genitalia; *c*, ventral view of subgenital plate ♀; *d*, dorsal view of dorsal plate of Xth segment; *e, f*, dorsal and lateral views of supra-anal lobe; *g*, titillators.

A. denticulata Tillyard. *h–k*, same parts as represented in *d–g*.

A. outeniquae n. sp. *l–o*, the same.

A. hawaquae n. sp. *p–s*, same parts; *r* shows the whole of Xth tergite and the pleurite with cercus, as in *a*.

divided into two arms posteriorly, and giving support to the chitinous framework of the recurved supra-anal lobe, which lies closely appressed to the tergite. Pleurites better marked than in *Aphanicerca*, but not disconnected, *i.e.* not freely movable or clasper-like. Titillators more or less elongate, with chitinous framework. In the resting position they curve upwards, and their tips lie in the groove at the hind end of the supra-anal lobe. Internal supporting struts slender, moderately long. Cerci as in *Aphanicerca.*

In ♀ abdominal segments VIII–X completely chitinised; segments II–VII with chitinised areas on sternites only. These latter segments have a trapezoidal plate or transverse band in posterior half, and a small transverse bar or spot on either side of the middle line in anterior half. Subgenital plate on VIIIth segment elongate-lanceolate. IXth sternite produced in a median membranous pointed process. Subanal plates triangular, rather elongate. Cerci very short, conical.

Nymph as in *Aphanicerca.*

Remarks.—The subgenital plate and the subanal plates of the ♀ have the appearance of forming an ovipositor, but the act of oviposition has not been observed.

The chitinisation of the ♀ abdominal sternites II–VII is characteristic; even if the posterior bands are feebly developed, though those on segments II and VII are fairly constant, the two anterior bars or spots on each segment are present.

Genotype.—Aphanicercella denticulata Tillyard.

Aphanicercopsis denticulata (Tillyard).

1931. Tillyard, *loc. cit.*, p. 121, figs. 5, 6*a*.

Imago.—In fore-wing cross-vein Sc-R at or before junction of Sc with C. Fork of R_{2+3} and R_{4+5} sessile or stalked. 1A usually meets the margin in a high angle, as in Tillyard's figure of *barnardi.* The kink or bend in Cu_2 above 1A and margin rather strongly marked. In hind-wing fork of R_{2+3} and R_{4+5} sometimes with the fork shorter than the stalk.

♂ *Genitalia.*—Subgenital plate elongate, apically curved upwards, basal appendage very small, usually a mere knob. Dorsal plate of Xth tergite hour-glass shaped, the anterior corners strongly chitinised and forming upturned points. Supra-anal lobe narrow, linguiform, without lateral lobes at base, its dorsal surface convex (except posteriorly), margins with several stout conical denticles on their lower surface. Titillators elongate, lanceolate, with strong chitinous supporting rod and membranous apex, the outer margin of which is slightly chitinised.

♀ *Genitalia.*—Subgenital plate forming an elongate spoon-shaped process, lanceolate when flattened out, tapering gradually to a bilobed apex, which is quite glabrous.

Fore-wing.—♂ 6–7 mm., ♀ 7–9 mm.

Nymph not distinguishable from that of *A. capensis.*

Localities.—Gt. Winterhoek Mts., Tulbagh (K. H. B., end August 1929, ♂♂, and September 1932, ♂♂♀♀; K. H. B. and H. G. W., November 1932, ♂♂♀♀).

Palmiet River, near Kleinmond (H. G. W., July 1932, 4 ♂♂, 1 ♀, and 2 apterous ♀♀).

Witte River, Wellington Mts. (H. G. W., October 1933, ♂♂♀♀).

French Hoek Pass (east side) (K. H. B., October 1933, 1 ♂, 2 ♀♀).

Aphanicercopsis tabularis n. sp.

Imago.—Venation and ♀ genitalia as in *denticulata.*

♂ *Genitalia.*—Subgenital plate with longer basal process than in *denticulata.* Dorsal plate of Xth tergite hour-glass shaped, but with broadly rounded anterior corners which do not form projecting knobs. Supra-anal lobe broader than in *denticulata,* with lateral basal lobes and fewer denticles; upper surface flat, usually with small apical knob. Titillators with the chitinous framework not so heavily chitinised as in *denticulata.*

Fore-wing.—♂ 3·5–5 mm., ♀ 5–7 mm. Exceptionally large specimens from Kirstenbosch measure ♂ 6–7 mm., ♀ 8–9 mm.

Colour as in *denticulata.*

Nymph, barring its smaller size, not differing from that of *A. capensis.* Subanal plates in ♀ nymphs nearing metamorphosis prominent, as they contain the subanal plates of the adult.

Localities.—Streams on slopes of Table Mt., Cape Town (K. H. B., July to October).

Nonna Kloof, Keeromberg, Worcester (K. H. B., September 1930, 1 ♂).

Remarks.—Very close to *denticulata,* but possessing four characters in the ♂ genitalia, any one of which is sufficient at a glance to distinguish the species.

Aphanicercopsis outeniquae n. sp.

Imago.—Venation as in *denticulata.*

♂ *Genitalia.*—Basal appendage of IXth sternite very well developed, larger even than in *tabularis*. Dorsal plate of Xth tergite similar to that of *tabularis*, but anterior corners less broadly rounded. Supra-anal lobe narrow, resembling that of *denticulata* but with lateral basal lobes, upper surface convex, margins with several denticles. Titillators short, clavate, the strongly chitinised framework forming an oblong with clear centre; no long apical process.

♀ Genitalia (specimen extracted from nymph) as in *denticulata*.

Fore-wing.—♂ 5·5 mm.

Colour as in *denticulata*.

Nymph as in *A. capensis*.

Localities.—George (Government Forest area) (K. H. B., January 1931, 1 ♂ and ♂♀ nymphs).

Robinson Pass, Outeniqua Range (K. H. B., February 1932, 1 ♂).

Montagu Pass, George (H. G. W., April 1933, 1 ♂).

Aphanicercopsis hawaquae n. sp.

Imago.—Venation as in *denticulata*.

♂ *Genitalia*.—Basal appendage of IXth sternite as in *tabularis*. Dorsal plate of Xth tergite oblong, with ear-like projections anteriorly, the posterior arms broad, with small intervening excision. Struts supporting the supra-anal lobe short and stout, the lobe broad at base (posterior), narrowing rather abruptly to the apical portion where the denticles are situated. Titillators stout, shorter and broader than in *denticulata*, but longer than in *outeniquae*, with short incurved apical process. ♀ unknown.

Fore-wing.—6·5 mm.

Colour as in *denticulata*.

Localities.—Witte River, Wellington Mts. (H. G. W., September 1933, 3 ♂♂).

French Hoek Pass (east side) (H. G. W., 1st October 1932, 1 ♂, and K. H. B., 1st October 1933, 1 ♂).

Jonkershoek, Stellenbosch (K. H. B. and H. G. W., 10th June 1932, 1 apterous ♂).

Remarks.—A species easily distinguished by the supra-anal lobe and the titillators. For apterous ♂ see *supra*, p. 517.

Gen. *Aphanicercella* Tillyard.

1931. Tillyard, *loc. cit.*, p. 124 (subgen. of *Aphanicerca*).

Imago.—Venation as in *Aphanicerca* and *Aphanicercopsis*. Wings rather strongly suffused, without clear patch on fore-wing. IXth tergite ♂ without process. IXth sternite short, with basal process. Dorsal area of Xth tergite with two oblong or subtriangular strongly chitinised plates (in one species coalesced into one plate), separated by a more or less triangular shield-like plate, and a transverse bar, to the ends of which is attached the supra-anal lobe. The latter is triangular or subtrapezoidal, projecting forwards and lying closely appressed to the dorsal surface between two small scabrous knobs, one on each dorsal plate. Pleurites deeply separated from the tergite, ending in sharp, strongly chitinised points, and capable of lateral movement. Titillators elongate, each half longitudinally grooved on upper surface, the membranous apex lying bent back in this groove in the resting position; often with supporting basal ear-like processes; internal supporting struts short. Cerci short, ovoid, apex with a clear space in which is a minute papilla, representing apparently the remnant of a 2nd joint.

In ♀ segments VII, IX, and X completely chitinised (VIIth sternite sometimes incompletely so). Segments II–VI with more or less well-developed chitinous areas on sternites only. Segment VIII completely membranous, except in one species (*nigra*), where there are small pleural chitinous areas. Subgenital plate on VIIth segment more or less strongly chitinised, not elongate, often gibbous. Subanal plates rounded. Cerci short, conical.

Nymph as in *A. capensis*, but more setose; some long setae on thorax, abdomen, and legs in addition to the ordinary short ones.

Genotype.—*A. barnardi* Tillyard.

Remarks.—The species of this genus are mostly smaller and darker than those of *Aphanicerca*, and like the *Aphanicercopsis* species they have no clear patch on the fore-wing. The movable pleurites of the ♂, which act as claspers, and the subgenital plate of the ♀ on the VIIth segment are the characteristic features.

Tillyard designated *barnardi* as the type of his subgenus because both sexes were known. This designation holds good, although the supposed female of the type-species proves to have been wrongly assigned.

Aphanicercella barnardi Tillyard.

1931. Tillyard, *loc. cit.*, p. 122, figs. 6*b*, 7, 8 (♂ only; not the ♀, fig. 9).

Imago.—Position of cross-vein Sc-R in fore-wing is variable, not always before end of Sc.

♂ *Genitalia.*—Subgenital plate in ventral view broader than long (but see p. 512), lateral margins often sinuous, producing a definite though blunt median point; basal process moderately large. Supra-anal lobe triangular with subacute apex, hinged at the posterior chitinised ends of the lateral margins to a crescentic transverse plate; in front of this a triangular plate lying between the oblong dorsal plates of the Xth tergite. Lateral margins of the supra-anal lobe with serrations on lower surface pointing towards base of lobe (not forwards as in Tillyard's figure); in side view the apex of the lobe may be slightly thickened, but never with recurved hook on lower surface. Titillators elongate, chitinised framework as figured, the two main struts being approximately of the same thickness; basal supporting processes well developed, apices rounded. Pleurites

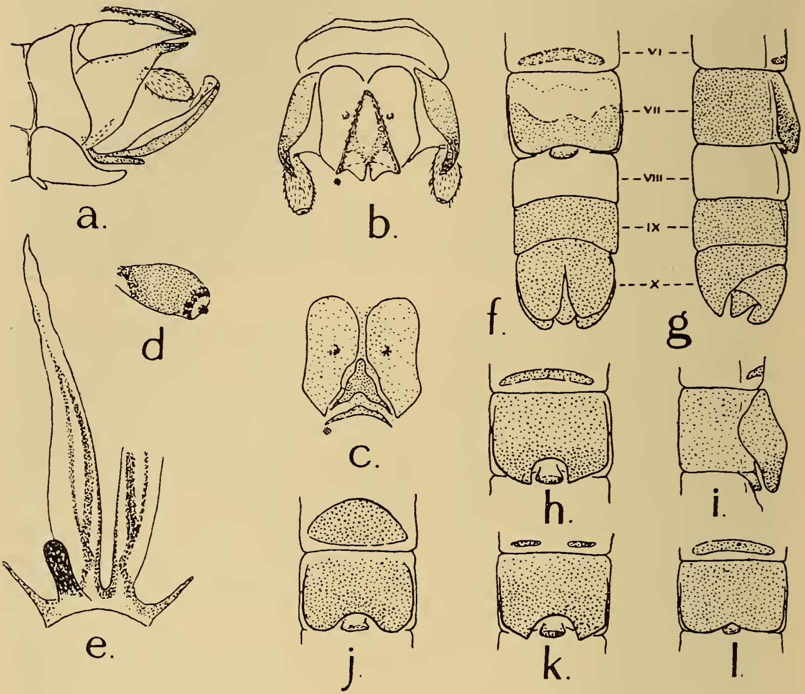

Fig. 15.—*Aphanicercella barnardi* Tillyard. *a*, *b*, lateral and dorsal views genitalia of ♂ from Fairy Glen (typical form); *c*, dorsal view of dorsal plates of Xth segment, with interpolated plate and transverse bar, to the ends of which the supra-anal lobe is attached; *d*, cercus; *e*, ventral view of titillators of Table Mt. form, the basal supporting process on right half omitted; *f*, *g*, ventral and lateral views of end of abdomen of ♀ from Fairy Glen (typical form); *h*, *i*, subgenital plate (segment VII) ♀ from Table Mt.; *j*, *k*, *l*, the same, from Jonkershoek, Palmiet River, and Schoester's River (Cape Peninsula) respectively.

triangular, upper posterior corner produced in a sharp, strongly chitinised, somewhat incurved point, often sub-bifid. Cerci short, ovate, apex subtruncate, pale, with minute papilla, a small area at base on ventral side also pale.

♀ *Genitalia.*—VIIth sternite (subgenital plate) strongly chitinised only in its posterior half, the anterior limit variable, the hind margin with shallow though variable median excavation. Posterior margins of each of sternites III–VI with narrow transverse band, sometimes interrupted in the middle; IInd sternite more or less completely chitinised.

Fore-wing.—♂ 5–5·5 mm., ♀ 6–6·5 mm.

Colour as given by Tillyard.

Nymph, as stated under the genus, does not differ from that of *A. capensis* (barring size), except in being more setose (see fig. 8, *i*).

Localities.—Fairy Glen, Brandwacht, Worcester (K. H. B., 4th June 1929, ♂♂; K. H. B. and H. G. W., August 1932, ♂♂♀♀, some in copula) (typical form).

Nonna Kloof, Keeromberg, Worcester (K. H. B., September 1930, ♀♀).

In other localities certain variations occur, but they are scarcely great enough to justify definite names, and, moreover, are connected by more or less transitional forms. In all of them the structure of the Xth tergite ♂ is the same.

Var. α.—♂ titillators with the inner supporting rod much stronger than the outer, the basal supporting process more slender. Supra-anal lobe with distinct recurved tip on lower surface.

♀ IInd and VIIth sternites fully chitinised, intervening sternites with rather strong transverse bands; hind margin of VIIth sternite slightly excised.

Localities.—Cape Peninsula, Lakeside Plateau (upper reaches of the Silvermine stream) (A. C. H., July 1933, ♂♀); middle reaches of Silvermine stream (A. C. H., 1931, ♂♂♀♀); Schoester's River (A. C. H., August 1930, ♀); Glencairn Valley (K. H. B. and H. G. W., August 1932, ♂♂♀♀, some in copula, nymphs).

Gt. Winterhoek Mts., Tulbagh (K. H. B., September 1932, ♂♂♀♀, some in copula).

Var. β.—♂ as in *α*. Apex of supra-anal lobe slightly enlarged, knob-like. ♀ IInd sternite nearly completely chitinised, the transverse bands on segments III–VI more or less interrupted medianly. VIIth sternite fully and strongly chitinised, rather strongly gibbous, its hind margin with deep subquadrate excision.

Localities.—Kasteel's Poort, Skeleton Ravine, and other ravines on Table Mt., Cape Town (K. H. B. and H. G. W., various dates June to November, ♂♂♀♀, many in copula, nymphs).

Witte River, Wellington Mts. (H. G. W., October 1933, ♂♂♀♀).

Var. γ.—♂ titillators as in typical form, but basal supporting processes more slender; apex of supra-anal lobe with recurved hook. ♀ IInd–VIth sternites with broad lenticular chitinous patch covering nearly whole of sternite; VIIth sternite nearly fully chitinised, its hind margin with semicircular excision between rounded lobes.

Locality.—Jonkershoek, Stellenbosch (K. H. B., July 1927; K. H. B. and H. G. W., June 1932, ♂♂♀♀).

Var. δ.—♀ IInd sternite nearly fully chitinised; IIIrd–VIth sternites with interrupted narrow transverse bands; VIIth sternite fully chitinised, slightly gibbous, hind margin with semicircular excision between pointed lobes. ♂ unknown.

Locality.—Palmiet River (H. G. W., July 1932, 1 ♀).

Aphanicercella scutata n. sp.

Imago.—Venation as in *barnardi.*

♂ *Genitalia.*—Subgenital plate and basal process as in *barnardi.* Supra-anal lobe triangular with blunt subtruncate apex, hinged posteriorly to a narrow transverse bar; in front of this a crescentic plate between the two dorsal plates of the Xth tergite, each of which has a sinuous lateral margin. Lateral margins of supra-anal lobe with very fine and close-set serrations. Pleurites as in *barnardi.* Titillators as in *barnardi*, but the basal supporting processes apically acute. Cerci ovate, the basal half chitinised only on upper side so that at first sight the cerci appear petiolate.

♀ *Genitalia.*—IInd sternite nearly fully chitinised; transverse bands on sternites III–VI nearly obsolete; VIIth sternite strongly and completely chitinised, gibbous, especially the two distal lobes, between which is a semicircular excision.

Fore-wing.—♂ 5 mm., ♀ 6 mm.

Colour as in *barnardi.*

Localities.—Witte River, Wellington Mts. (H. G. W., September 1933, 1 ♂, 3 ♀♀). French Hoek Pass (east side) (H. G. W., October 1932, 1 ♀).

Remarks.—The Xth tergite and supra-anal lobe of ♂ clearly separate this species from *barnardi*; the ♀ bears a strong resemblance to the Table Mt. form of the latter species. The sexes are assumed to be conspecific, but were not actually caught in copula.

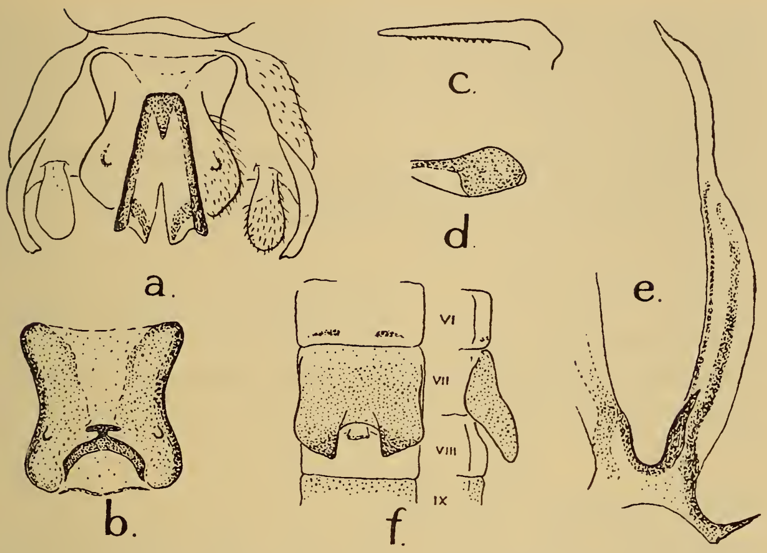

FIG. 16.—*Aphanicercella scutata* n. sp. *a*, dorsal view ♂ genitalia; *b*, dorsal view of dorsal plates of Xth segment, with interpolated plates; *c*, lateral view of supra-anal lobe; *d*, cercus; *e*, ventral view of titillators, basal process on left side omitted; *f*, ventral and lateral views of segments VI–IX ♀.

Aphanicercella cassida n. sp.

Imago.—Venation as in *barnardi.*

♂ *Genitalia.*—IXth sternite of usual shape, but with very large basal process extending to middle of sternite. Supra-anal lobe helmet-shaped, with small acute apical point; basal excision wide, hinged to a crescentic bar, in front of which is a triangular plate, as in *barnardi*, but the apex blunter and the arms more widely divergent.

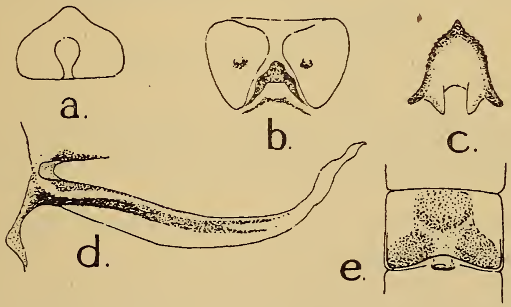

FIG. 17.—*Aphanicercella cassida* n. sp. *a*, IXth sternite ♂; *b*, dorsal plates of Xth tergite; *c*, supra-anal lobe; *d*, titillator; *e*, subgenital plate (VIIth sternite) ♀.

Dorsal plates of Xth tergite shorter and broader than in *barnardi.* Titillators with a single broad supporting rod, apically bifid, and basally strongly chitinised; no basal supporting processes. Pleurites and cerci as in *barnardi.*

♀ *Genitalia.*—IInd sternite fully but not strongly chitinised; transverse bars on sternites III–VI obsolete; VIIth sternite with trilobate chitinised area, hind margin slightly excavate.

Fore-wing.—♂ 6 mm., ♀ 7 mm.

Colour as in *barnardi.*

Locality.—Kaaiman's Gat, near Wilderness, George District (H. G. W., 16th April 1933, 1 ♂, 3 ♀♀).

Remarks.—A species with distinctive supra-anal lobe. The sexes were not caught in copula.

Aphanicercella bifurcata n. sp.

Imago.—Venation as in *barnardi.*

♂ *Genitalia.*—IXth sternite with basal process larger than in *barnardi*, but not as large as in *cassida.* Dorsal plates of Xth tergite as figured for *quadrata* (fig. 19, *a*). Supra-anal lobe anteriorly bifurcate, the distance between the horns more than twice in the length of lateral margin, which is slightly convex where the serrations are situated. Titillators without basal supporting process, the outer strut well developed, the inner usually only developed distally, often with a slight prolongation into the membranous apex (*cf. cassida*, fig. 17, *d*). Pleurites and cerci as in *barnardi.*

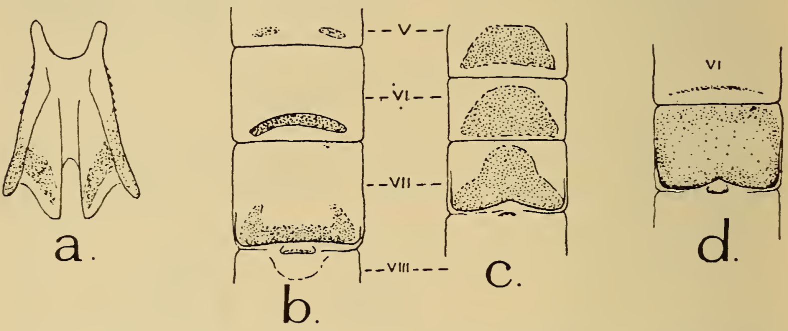

Fig. 18.—*Aphanicercella bifurcata* n. sp. *a*, supra-anal lobe; *b*, ventral view of abdominal segments V–VIII ♀ from River Zonder End Mts.; *c*, the same from Gt. Winterhoek Mts.; *d*, segments VI–VIII of ♀ from Montagu Pass.

♀ *Genitalia.*—IInd sternite nearly completely but feebly chitinised; transverse bars on sternites III–V obsolete, but that on VI usually distinct; VIIth sternite with chitinised bar on hind margin, the ends laterally projecting a little forwards, hind margin straight.

Fore-wing.—♂ 5·5 mm., ♀ 6–6·5 mm.

Colour as in *barnardi.*

Localities.—Oudebosch, River Zonder End Mts., 1500–3500 feet (K. H. B., January 1919, 1 ♀, and November-December 1928, ♂♀ in copula; H. G. W., January 1933, ♂♂♀♀; K. H. B. and H. G. W., January 1934, ♂♂♀♀).

Tradouw Pass, Langeberg Range, near Swellendam (K. H. B., October 1925, 2 ♂♂, 2 damaged ♀♀).

The following local variations occur in the chitinisation of the ♀ sternites, though the ♂♂ do not differ from the above.

Var. α.—VIIth sternite with chitinised band around all margins, feeblest on anterior margin; transverse bar on VIth sternite very feeble.

Locality.—Montagu Pass, Outeniqua Mts., George (H. G. W., 14th April 1933, ♂♂♀♀).

Probably also George (Government Forest area) (K. H. B., January 1931, 1 ♂).

Var. β.—All sternites II–VII with strongly chitinised trapezoidal area, that on sternite VII somewhat trilobate.

Localities.—Gt. Winterhoek Mts., 4000–5000 feet (K. H. B., September 1932, ♂♂♀♀).

Matroosberg, Hex River Mts. (northern slopes on Ceres side), 6000 feet (K. H. B., September 1933, ♂♀♀).

Aphanicercella quadrata n. sp.

Imago.—Venation as in *barnardi.*

♂ *Genitalia.*—Resembling *barnardi* in the IXth sternite and titillators, but the latter without basal supporting processes. Dorsal plates of Xth tergite intermediate between those of *barnardi* and *cassida.* Supra-anal lobe subquadrangular, the anterior margin excised, the distance between the horns one-half the length of lateral margin, lateral margins subparallel, straight, with minute serrations.

♀ *Genitalia.*—Subgenital plate strongly chitinised, except near anterior margin, hind margin with wide semicircular excision. IInd sternite not strongly chitinised, transverse bands on sternites III–V obsolete, a faint bar on sternite VI.

Fore-wing.—♂ 5 mm., ♀ 6 mm.

Colour as in *barnardi.*

Locality.—Cedar Mts., Clanwilliam District, 4000–5000 feet (K. H. B., September 1923, 2 ♂♂, 2 ♀♀).

Remarks.—It is perhaps doubtful whether this is not merely an extreme variation of *bifurcata*. It is, however, very distinct both in the supra-anal lobe of ♂ and VIIth sternite of ♀, and may for the time being stand as a distinct species. The sexes were not caught in copula.

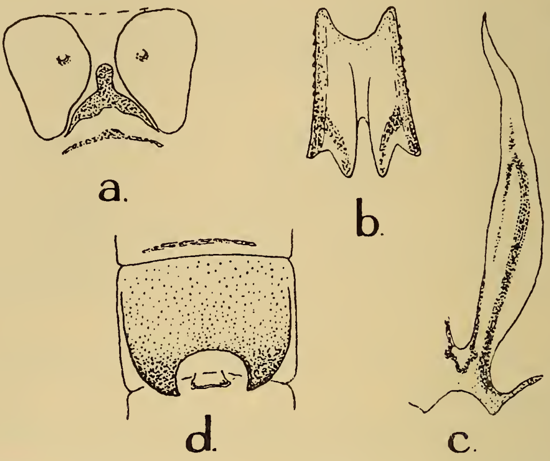

FIG. 19.—*Aphanicercella quadrata* n. sp. *a*, dorsal plates of Xth tergite; *b*, supra-anal lobe; *c*, titillator; *d*, abdominal segments VI–VIII ♀.

Aphanicercella nigra n. sp.

Imago.—Venation as in *barnardi.*

♂ *Genitalia.*—IXth sternite with large basal process, almost as large as in *cassida*. Dorsal plates of Xth tergite fused into a single transverse plate, together with the interpolated piece, but leaving two clear membranous triangular patches. Supra-anal lobe subquadrangular, basal width equal to lateral margin, with deep angular excision anteriorly, projecting posterior lobes very minutely setulose. Titillators as in *scutata*, but the ends of the supporting rods more strongly chitinised, basal supporting processes acute. Pleurites as in *barnardi*. Cerci appearing petiolate as in *scutata.*

♀ *Genitalia.*—IInd sternite fully chitinised, transverse bands on IIIrd–VIth sternites obsolete. A transverse band on the nearly straight hind margin of VIIth sternite. Vulva wide. VIIIth segment with small pleural chitinous patch on either side, otherwise membranous.

Fore-wing.—♂ 6 mm., ♀ 7 mm.

Colour.—Head and thorax very dark vandyke brown, almost black. Wing membranes by reflected light almost black, by transmitted light very strongly suffused; a clear (white) narrow longitudinal streak in the space between Rs and MA, beginning near junction of MA with Rs and extending to just beyond anastomosis, the cross-vein R_{4+5}–MA_1 being interrupted; a second clear streak following the course of Cu_2 on its lower (anal) side from base nearly to apex; similar clear streaks, but less conspicuous, on hind wing. Abdomen castaneous, the chitinised portions dark vandyke brown.

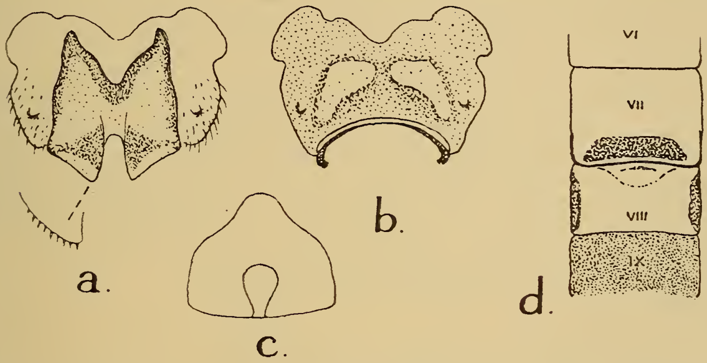

FIG. 20.—*Aphanicercella nigra* n. sp. *a*, supra-anal lobe; *b*, dorsal plates of Xth tergite; *c*, subgenital plate (IXth sternite) ♂; *d*, ventral view of abdominal segments VI–IX ♀.

Eggs ovoid, ·2 mm. long diameter, without sculpture or micro pylar projection.

Locality.—French Hoek Pass (east side) (K. H. B., 1st October 1933, 1 ♂, 3 ♀♀; H. G. W., 8th October 1933, 1 ♂, 1 ♀).

Remarks.—A very distinctive species both on account of its coloration and the ♂ and ♀ genitalia. Although not caught in copula, there is no doubt in this case that the sexes are conspecific. The width of the vulva is evidently correlated with the width of the supra-anal lobe; and the fusion of the dorsal plates of the Xth tergite may help to give more support to this accessory copulatory structure.

The clear streaks on the wings are not peculiar to this species, being present in all the South African Nemourines; but here they are very conspicuous owing to the very deep suffusion of the wing membranes.

While some of the other species of this genus, and of *Aphanicercopsis*, are of a deep brown colour, sometimes very dark brown (the colour fades in dried or alcoholic material), this species is nevertheless outstanding in its almost black coloration. In the field the flies appear quite black.

Gen. *Desmonemoura* Tillyard.

1931. Tillyard, *loc. cit.*, p. 126.

Imago.—♂ like *Aphanicercella*, but with elongate IXth sternite, well demarcated pleurites, each with a long falcate process, and elongate falcate (but single-jointed) cerci.

♀ like *Aphanicerca*, but cerci better developed. The subgenital plate is on VIIIth segment, and there is a saddle-like area on the VIIth sternite; both this and the subgenital plate more strongly chitinised than the rest of their respective segments, but not as strongly as the IXth and Xth tergites. Sternites II–VI and IX and X membranous, and without transverse bars.

Wings banded alternately with light and dark.

Eggs.—*Infra*, p. 548.

Nymph not differing from that of *Aphanicerca.*

Genotype.—*D. pulchellum* Tillyard.

Remarks.—The main character relied upon in the institution of this genus, viz. the common stalk of Rs and M, proves to be accidental; out of many specimens examined it occurs only in the holotype ♂. Moreover, by an unfortunate error, due apparently to the mix-up of abdomens during preparation and mislabelling of the microscope slides, the true ♀ of *Desmonemoura* was described as that of *Aphanicercella barnardi*. The description given for the ♀ of *Desmonemoura* was taken from dried specimens (there is no ♀ mounted on a slide labelled as *Desmonemoura*), and is valueless.

In contrast with the preceding genera, the several species of which each have apparently a somewhat limited distribution, only one widely distributed species of *Desmonemoura* has up to the present been discovered.

Desmonemoura pulchellum Tillyard.
(The Porcupine Stone-fly.)

1931. Tillyard, *loc. cit.*, p. 126, figs. 10, 11, and 9 (♀ ascribed to *A. barnardi*).

Imago. ♂ *Genitalia.*—IXth tergite produced backwards over Xth tergite in two processes with strongly chitinised, somewhat knobby apices. IXth sternite elongate-triangular. Supra-anal lobe scimitar-like in lateral view, linguiform in dorsal view, bearing 5–6 denticles

on each side, folding down over the two dorsal plates of Xth tergite, each of which has a small chitinous knob; the chitinised lateral margins of the lobe are curved round and continued as two rods between the chitinised inner margins of the dorsal plates. Titillators rather stout, fused in their basal half, apices abruptly narrowed. Cerci setose, but the falcate processes of the pleurites are glabrous.

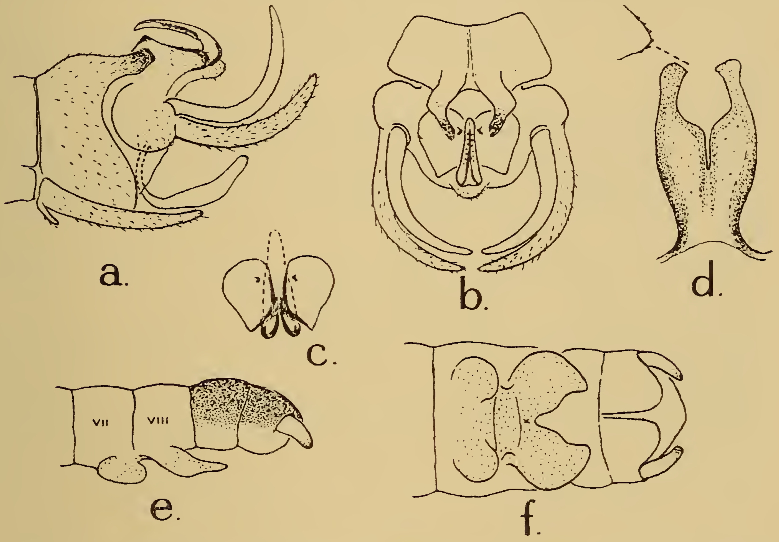

Fig. 21.—*Desmonemoura pulchellum* Tillyard. *a*, *b*, lateral and dorsal views ♂ genitalia; *c*, dorsal plates of Xth segment, the outline of the supra-anal lobe dotted; *d*, titillators; *e*, *f*, lateral and ventral views of abdominal segments VII–X ♀.

♀ *Genitalia* (*cf.* Tillyard's figure 9 as *A. barnardi*).—VIIth sternite with transverse oval patch rather more strongly chitinised than the rest of segment, the lateral portions rather gibbous and the central portion concave, hence saddle-shaped. Subgenital plate on VIIIth segment bilobate, with deep triangular excision, apices rounded. Cerci cylindrical, shorter than in ♂, but longer than in the other genera.

Fore-wing.—♂ 6 mm., ♀ 7–8 mm.

Colour.—Upper surface of head, meso- and meta-thorax blackish. Basal joints of antennae pale, subsequent joints brown, distal joints dark brown. Upper surface of prothorax lemon-yellow, of abdomen pale yellowish-brown. Lower surface of head, thorax, and abdomen pale yellowish-white. Genitalia brown. Wings banded with black and pale lemon-yellow. (The black fades in dried or alcoholic specimens.)

Egg.—As in the other genera, but a trifle narrower in proportion to its length (width $\frac{3}{5}$ instead of $\frac{2}{3}$ the length).

Nymph as in *Aphanicerca capensis.*

Localities.—Banhoek, Stellenbosch (K. H. B., 7th October 1929, 1 ♂, 1 ♀).

Gt. Winterhoek Mts., Tulbagh, 3000–5000 feet (K. H. B., November 1917,[*] 2 ♂♂, 1 ♀; and K. H. B. and H. G. W., November 1932, ♂♂♀♀).

Hex River, Worcester (A. C. H., 5th October 1931, 1 ♀).

Tradouw Pass, Langeberg Range (K. H. B., October 1925, 3 ♀♀).

Oudebosch, River Zonder End Mts., 1500 feet (H. G. W., December 1931, 4 ♀♀, and January 1933, 1 ♀; K. H. B. and H. G. W., January 1934, 9 ♀♀).

Hottentots Holland Mts., 2500 feet (east side of Sugar Loaf) (K. H. B. and H. G. W., November 1932, 1 ♂).

Groot Drakenstein (K. H. B. and H. G. W., October 1933, ♂♂ and nymphs).

Remarks.—The holotype ♂ shows Rs and M with common stalk as in Tillyard's figure 10. Another mounted specimen, sex not stated, has Rs joined to R by a right-angled bend as in *Aphanicerca.* All other specimens which I have examined agree with the latter. The common stalk of Rs and M in the one specimen chosen as the holotype, therefore, was accidental, and this character must be omitted from the generic diagnosis.

The ♂ specimens from which the present figures of the genitalia are drawn appear to agree in all respects with the holotype slide from which Tillyard's figure 11 was drawn. The latter is squashed flat dorso-ventrally, and the true identification and position of the various parts without previous examination "in the round" would be almost impossible.

The ♀♀ from all the above localities agree in all respects one with another and with Tillyard's figure 9. In the Gt. Winterhoek Mts. (November 1932) a pair was found in copula entangled in a spider's web, which finally settles any doubt as to the correct ♀ of *Desmonemoura.* Unfortunately the actual mode of copulation and position of the ♂ copulatory structures could not be determined.

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[*] The date should really be 1916.